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Final Report

The objectives of the mini-sabbatical leave were to develop new ideas and possibly establish collaborative interactions between LANL, Durham University (Prof. Monkman group), University of Houston (Prof. Bittner group), G. Tech (Prof. Silva group), and University of St. Andrews (Prof. Keeling group) to address a set of problems in preparing quantum coherent condensed matter systems (based on low-dimensional semiconductor heterostructures, 2D TMD materials, and/or organic molecular assemblies) in photonic and plasmonic cavities, achieve control and ability to manipulate quantum entanglement in such systems, and use polariton states to transfer the entanglement to photon pair states. During the sabbatical visit, Piryatinski has presented his preliminary results as seminar talks both at the University of St. Andrews and Durham. Communications with Monkman group members were focused on the use of organic fluorescent material to play a role of active medium in photonic-plasmonic cavities with possibilities to create entangled states. Communications with Keeling group members and Prof. Bittner were focused on the discussion of our current, Dicke model based examination of the non-equilibrium phase diagram in a plasmonic cavity. Such communications were extremely helpful and resulted in a significant improvement of the models that were done during the sabbatical leave. The results are submitted for publication (A. Piryatinski, *et. al.*, *Non-equilibrium states of plasmonic Dicke model with coherent and incoherent surface plasmon-quantum emitter couplings*, arXiv:1909.01619). Following up the mini-sabbatical leave, Prof. Keeling and Silva were invited to LANL and presented IMS lectures. Communications with Prof. Silva, resulted in our contact to the DOE BES office in order to prepare and submit research proposal considering use of atomically layered perovskite materials as an active medium in photonic cavities.